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U. S. DEPARTMENT OF AGRICULTURE

Crosswise Loading of Long-type Watermelons

Marketing Research Report No. 133

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HIGHLIGHTS

Shipping experiments by rail from Florida, Georgia, and South Carolina to northern markets with the Congo variety of watermelon during the 1953 and 1954 seasons disclosed that loading this long-type melon crosswise of the car resulted in a reduction of 71.6 percent in melon bruising, 68 percent in the number of cracked melons, and 30.6 percent in surface scarring as compared with loading melons lengthwise of the car (the conventional method). The overall reduction in total external damage to melons was 70.5 percent. Observations were made on a total for both seasons of 111 test cars with the melons loaded crosswise and 109 companion carloads of comparable melons loaded lengthwise.

The research was begun in the 1953 watermelon shipping season in the southeast in an effort to develop a new loading method for the Congo and several other new varieties of melons, including the Fairfax and Charleston Gray, which had shown high degrees of susceptibility to blossom-end bruising in rail transportation. The Congo melon in the 1952 season, for example, had averaged 10.3 percent damaged melons per car as compared with 5.2 percent damage for the Cannonball variety, which, by the 1954 season, the Congo had largely supplanted in some producing areas. The new varieties of melons are disease resistant, prolific, and have good eating qualities. It was for the purpose of enabling the watermelon industry and consumers to realize the advantages of these improved varieties that this research was undertaken.

Inspection of sample melons upon arrival at terminal markets in 1954 indicated that there was no significant difference in the amount of internal damage in melons loaded crosswise and in those loaded by the conventional lengthwise method. The amounts of internal damage found upon arrival were apparently more closely related to maturity of the melons at time of shipment than to the loading method. In fact, evidence developed by experiment station workers of Florida, Georgia, and South Carolina indicates that much of the internal bruising was present in the melons at the time of shipment.

Melons from the third and later pickings of the crop loaded by both the crosswise and lengthwise methods sustained more external damage (cracking and bruising) in transit than melons from the first and second pickings. The conventional lengthwise shipments from the third and later pickings had 25.2 percent more damage than shipments from the first and second harvests. In the crosswise load the comparable increase in damage was 23.1 percent.

In the lengthwise load 94 percent of all external bruises was on the blossom ends of the melons. In contrast only 38.3 percent of the external bruises in the crosswise load was on the blossom ends, but a greater percentage of the bruising occurred on the sides of the melons. More externally damaged melons were found in the ends of cars than in the doorway area.

The best pattern of crosswise load was that with all melons loaded crosswise of the car. Crosswise loads with lengthwise rows of melons along alternate sides of each layer to obtain a higher carload weight sustained 105.9 percent more damage than the all-crosswise load. Most of the increased damage in the load with the lengthwise rows consisted of blossom-end bruising.

Impact registers showed that crosswise loads received more impacts and impacts of greater intensity than comparable lengthwise loads. However, they averaged only about one-third as much damage in transit. More than 79 percent of all lengthwise impacts received by shipments of both types of loads in both seasons occurred in yards and terminals.

CROSSWISE LOADING OF LONG-TYPE WATERMELONS

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BACKGROUND OF STUDY

Although watermelons have always sustained considerable loss and damage in rail shipment, the problem has become more acute in recent years in shipments from the southeastern producing areas to northern markets. Most of this substantial increase in melon damage has been directly attributable to the increased production and shipment during the last 5 years of several new and improved varieties of long-type melons that are considerably more susceptible to bruising than the older varieties of round-type melons.

The most commercially important of the new varieties are the Congo and Charleston Gray. They are disease resistant, comparatively prolific, and have excellent eating qualities, as compared with the Cannonball and Black Diamond varieties. However, because of their thin and somewhat flexible rinds at the blossom ends, the new varieties have averaged about twice as much damage in transit as the Cannonball.

Railroad freight claim payments for damage, as reported by the Association of American Railroads, have averaged over 1 million dollars a year for the past 8 years. Such payments serve as a barometer of the cost of this loss. Claim payments per car for watermelons increased from an average of $37.10 in 1952 to $65.53 in 1953. The total claim payments for watermelons in 1953 amounted to $1,656,322, or $19.75 per $100 of revenue received by the carriers for hauling this commodity.

Concern over the increasing cost of this damage led to a program of research beginning in the 1953 season by the Department of Agriculture in cooperation with the agricultural experiment stations of Florida, Georgia, and South Carolina and cooperating railroads, shippers, and receivers to find a better method of loading melons. During the 1953 season the crosswise load for long-type melons was developed. The results of the first season's experiments with the crosswise load were published in Marketing Research Report No. 62, *Studies of Watermelon Loading for Rail Shipment, 1953,* released in May 1954.

Results of the shipping tests during the 1953 season showed that loading the Congo variety of melons crosswise of the car instead of lengthwise (the conventional method) reduced bruising 70 percent and cracking 69 percent. Surface scarring was reduced 47 percent. The new loading method entailed little or no increase in loading time or material costs after the loaders became familiar with it. Shipments of 50 test cars loaded crosswise and 52 check cars loaded in the conventional manner were studied during the 1953 season.

Shipping experiments were continued in 1954 when observations were made on 59 test cars loaded crosswise and 59 check cars loaded lengthwise to study possible further improvements in the new method. This report presents the results of the 1954 season's shipping experiments and summarizes the findings of the research conducted in both the 1953 and 1954 seasons.

LOADING AND SHIPPING METHODS

Watermelons, unlike most perishables, are transported in bulk. The railroad car or truck in which they are shipped is; in effect, the container. This means that they are subject to the full force of any impact transmitted to the car containing them. Since these impacts are sometimes intense enough to damage or destroy even heavy wooden shipping containers, it is not surprising that melons loaded in bulk have always sustained substantial damage.

Various types of freight cars are used in transporting watermelons. Ventilated boxcars are most common in the Southeast, while in the Southwest area--Texas and Oklahoma--the stockcar is the principal type. In both areas use of the refrigerator car is increasing as the number of ventilated boxcars and stockcars decreases, and in California and Arizona the refrigerator car is used exclusively for rail shipment of watermelons. Research has disproved the idea that the refrigerator car is not satisfactory for transporting watermelons. 1/

The Lengthwise Load

The lengthwise method of loading watermelons is illustrated in figures 1 and 2. By this method the melon is placed on its side with its longest dimension paralleling the length of the car and with its stem end toward the doorway of the car. Given a sufficient number of melons and enough loaders, both ends of the car can be loaded at the same time. The first diagram in figure 2 presents a top view of the lengthwise load with the melons in the second layer 2/ superimposed upon the bottom layer and shows how the load is begun at each end of the car with a crosswise line of melons. This crosswise line occurring at the ends of the first and third layer results in each layer of melons being offset in relation to the layer immediately above or below. The number of rows 3/ loaded across the car varies with the transverse diameter of the melons. The lower diagram in figure 2 illustrates a cross section view of a stack 4/ of melons. Both of these diagrams reveal how the melons of one layer fit into the V shaped gaps formed by adjacent melons in the layer below.

When lengthwise loading is begun at each end of the car, the two sections of the load may be loaded simultaneously and brought together in the doorway area. A space between the two sections of the load not sufficient to accommodate a stack of melons loaded lengthwise sometimes results. Depending upon the width of the space, the gap is usually filled with one or more stacks of melons loaded crosswise of the car. It has long been noted that these

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1/ Gerrity, M. V., and Breakiron, P. L. Loss and Damage in Rail Transportation of Watermelons in Relation to Variety of Melon, Type of Car, and Type of Protective Material. Processed, 31 pp. U. S. Dept. Agr., Prod. & Mktg. Admin.

Kaufman, J., Melons Keep Well on Track in Ventilated Refrigerator Cars, Marketing Activities, vol. 19, No. 5, U. S. Dept. Agr., May 1956.

2/ A layer is a course or stratum of melons 1 melon high.

3/ A row is a line of melons extending lengthwise of the car, 1 melon in width.

4/ A stack is a pile of melons or cross section of the load from one side wall to the other and from the top to the bottom of the load, 1 melon in length.

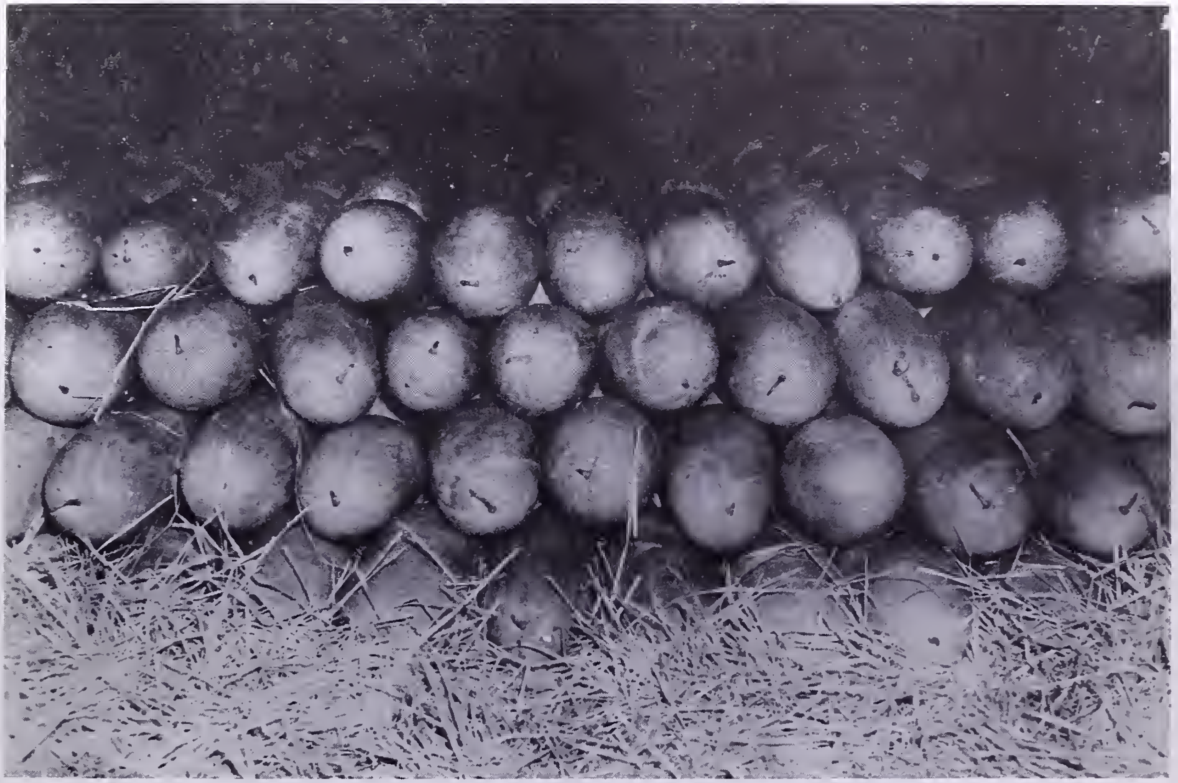

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Figure 1.--Cross section of one of several common lengthwise arrangements of Charleston Gray watermelons in doorway area of ventilated boxcar. This photograph was taken during loading of car at shipping point.

so-called doorway filler stacks sustain very little damage in transit compared with other parts of the load. Their location in the car rather than the arrangement of the melons was thought to account for their lower incidence of damage.

The traditional lengthwise load, while never entirely satisfactory even for the tough, thicker rind varieties like the Cannonball (a round-type melon) and the Tom Watson, is even less so for the newer varieties of melon. As was indicated earlier, these newer varieties, while more resistant to disease, have thinner, more flexible rinds, especially at the blossom end. Under the stem-end-to-blossom-end arrangement of melons in the lengthwise load, the hard stem end is forced against the weaker blossom end.

The thinner, weaker rind of the Congo and other new long-type melons does not, however, entirely account for the excessive damage to the blossom end when these melons are loaded lengthwise (fig. 3). The Cannonball has, in comparison to the Congo, a blunt stem end and a somewhat cupped or concave blossom end. This means that in a lengthwise load of Cannonball melons the area of contact between the stem and blossom ends is considerably greater and the pressure from lengthwise impacts is spread over a larger area.

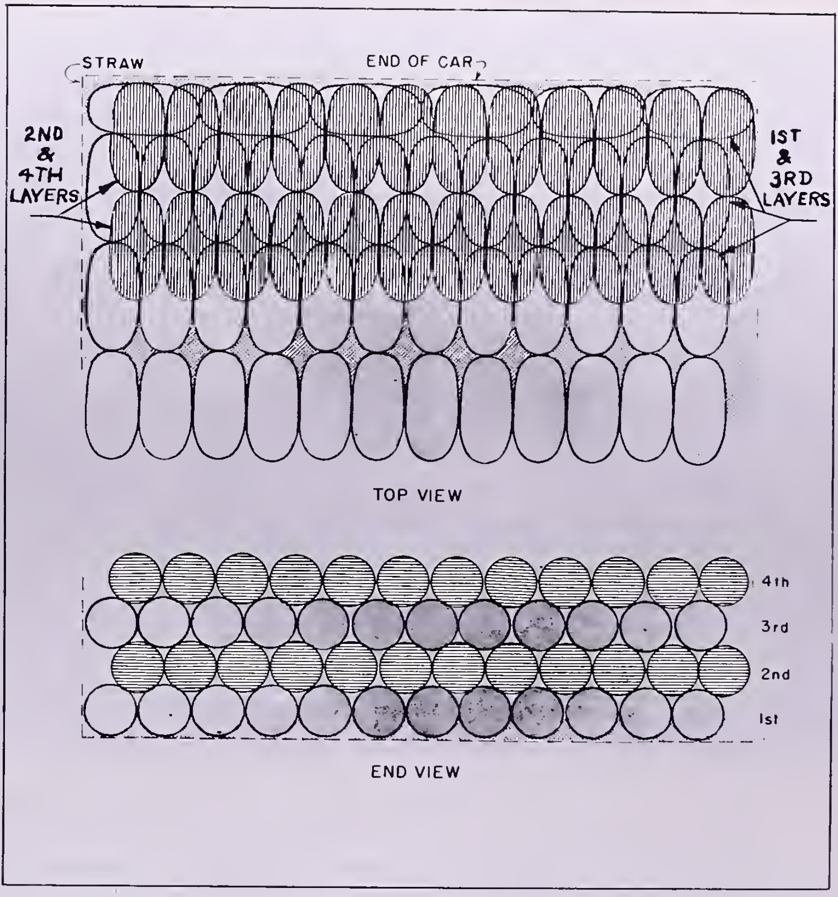

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Figure 2.--Top and end views of conventional lengthwise load, showing arrangements of long-type melons. In the top sketch the second layer of melons is superimposed on the first, or bottom, layer of melons. In the end view note that melons in the 3 upper layers rest in depressions between adjacent melons directly beneath them.

Other Loading Methods

Results of experimental work done some years ago indicated that variations of the conventional lengthwise load will not significantly reduce either the kind or the amount of damage which has characterized this type of load. 5/ In 1952, the railroads, in cooperation with a number of shippers and receivers, undertook a limited experiment with the so-called jumble load. This is simply a haphazard arrangement of melons in the car. Two shipping tests were made during this season and the results were favorable. Receivers, however, indicated so little interest in this type of load that no further tests of it were made.

5/ Winston, J. R. Report of Watermelon Shipping Tests from South Carolina. Handling, Transportation, & Storage Off. Rpt. No. 156, U. S. Bur. Plant Indus., Soils, & Agr. Engin., July 1946.

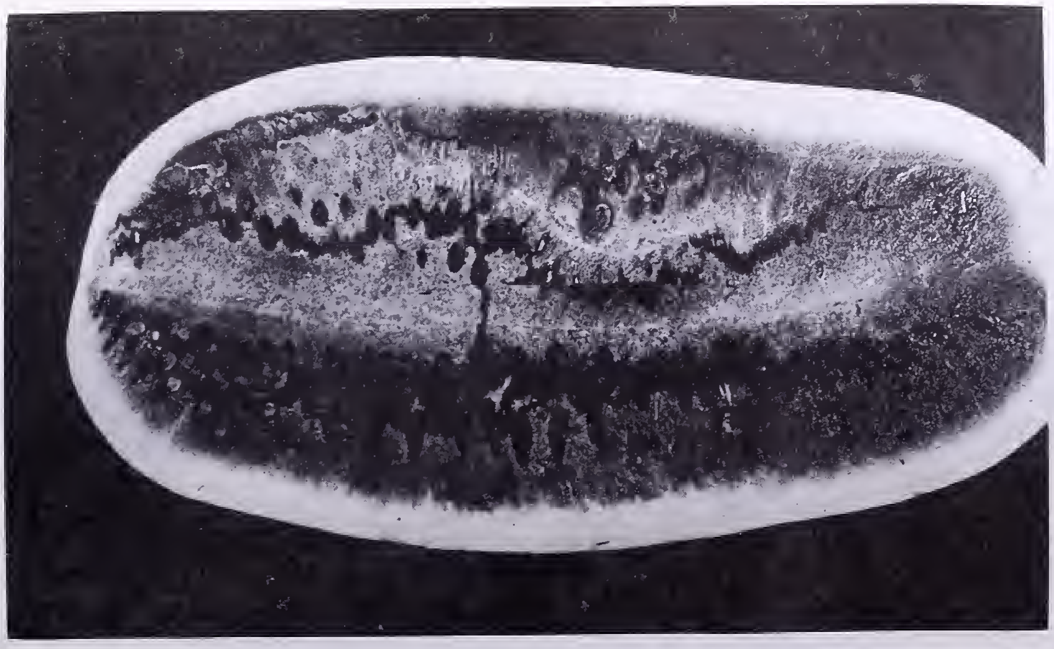

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Figure 3.--Cross section of Congo melon showing internal damage to flesh adjacent to externally bruised blossom end. Note comparative thinness of rind at blossom end as contrasted with that on sides of melon.

The Crosswise Load

Damage to fragile agricultural commodities in the normal course of rail transportation can be materially reduced, and in some instances virtually eliminated, if the commodity, or the container in which it is shipped, can be loaded in such a way that the lengthwise impacts transmitted to the load can be received by the strongest part of the container. 6/ Crosswise loading of watermelons, tested in 1953 and 1954, involves the application of this principle to bulk shipment. 7/

The basic characteristic of the crosswise loading pattern is that the watermelons are placed in the cars with their ends pointed toward the sides of the car. The advantage of this type of loading is that the lengthwise impacts transmitted to the load are taken on the sides of the melons rather than the ends. The rind of the side is thicker and tougher than the ends, but even more important, the force of the impact is spread over a greater surface area of the melon. (Figs. 4 and 5.) The pressure per square inch of rind surface produced by the impact transmitted to the load is thus substantially reduced.

6/ Breakiron, Philip L. Reduction of Loss and Damage in Rail Transportation of Fresh Fruits and Vegetables by Improved Loading Methods. U. S. Bur. Agr. Econ., Aug. 1946.

7/ The idea for the crosswise load for long-type watermelons was first conceived by J. R. Winston in 1946 in connection with shipping tests that were being made at that time from South Carolina with the Garrison, a long-type melon with a thin, fragile rind. (See footnote 5.) However, no tests of this method were made until 1953.

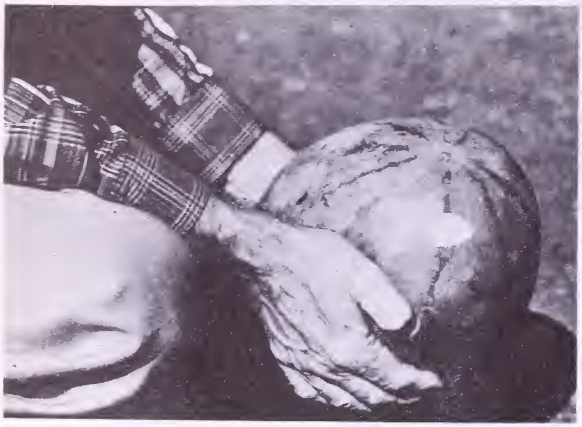

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Figure 4.--The spot of white paint on the blossom end of this melon shows the approximate area of contact between melons in the conventional lengthwise load. The stem end of a second melon covered with white paint was pressed against the blossom end of the melon shown here.

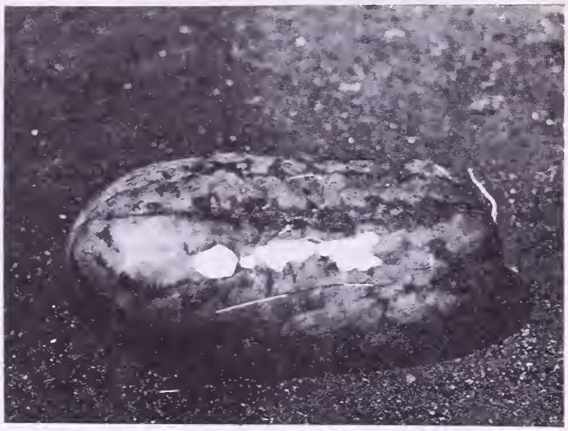

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Figure 5.--The white paint on the side of the melon in this photograph shows the greater area of contact between melons in the crosswise load. A second melon with one side covered with white paint was packed next to the melon shown here.

Various modifications in the arrangement of melons in the crosswise load are illustrated in figures 6, 7, and 8. The top diagram in each of these figures shows the first 2 cross car lines of melons in the second layer superimposed on the melons in the first or bottom layer.

In figure 6, all of the melons in the load are placed crosswise of the car and each layer is loaded so that the melons in it offset those in the layer immediately above and below it. This pattern creates a void at both ends of every other line of melons in each layer. These voids should be filled with straw or some other cushioning material.

The modifications in the melon arrangement illustrated in figures 7 and 8 differ only in that 4 lengthwise rows of melons are used in the crosswise load. Figure 7 shows 2 lengthwise rows along each side of the car in layers 1 and 3. In figure 8 there is one lengthwise row in each layer on alternating sides of the car.

The loading pattern shown in figure 6 was the one primarily used in the tests reported here. While achieving the full advantage of the crosswise load, this pattern has the disadvantage of producing loads from 5 to 10 percent lighter than a lengthwise load of melons of the same size. The disparity in weight is, of course, caused by the 2 alternating voids occurring along the sides of the load. This objection is largely overcome in the load patterns illustrated in figures 7 and 8. In these patterns, the voids at the sides of alternating layers are filled by lengthwise rows of melons.

The advantage of the additional weight provided by these lengthwise rows is offset to the extent that the melons in them, as in any lengthwise arrangement, are susceptible to greater blossom-end damage than melons loaded crosswise. Also, the melons in these 4 lengthwise rows being next to the side walls of the car, are vulnerable to scarring or friction bruising.

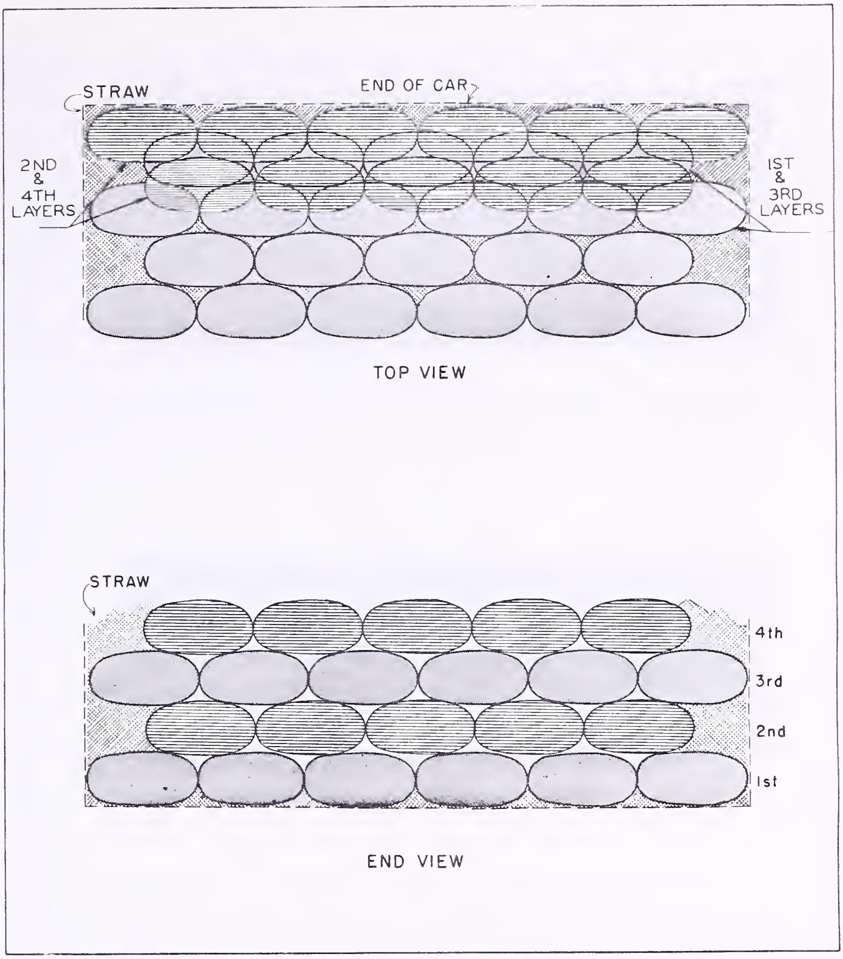

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Figure 6.--Top and end views of crosswise load, showing arrangement of long-type melons. In the top view 2 stacks of melons in the second layer are superimposed upon first, or bottom, layer of melons. The first line of melons in the bottom layer is loaded one-half the width of a melon away from the end wall of the car. Note in top view that melons are offset from those in bottom layer as they rest in depression between 2 melons in bottom layer, or between the first stack of bottom layer melons and the end wall of the car.

Figures 9, 10, and 11 show, step by step, the method of constructing a crosswise load.

Test Shipment Procedure

Prior to the beginning of the 1953 shipping tests the incidence of damage in a 10-percent random sample of car unloads in 41 terminal markets in 1952 was analyzed in order to develop data required for an experimental design for a series of shipping experiments with one loading method. It was determined from this analysis that a minimum of 100 test cars utilizing a given

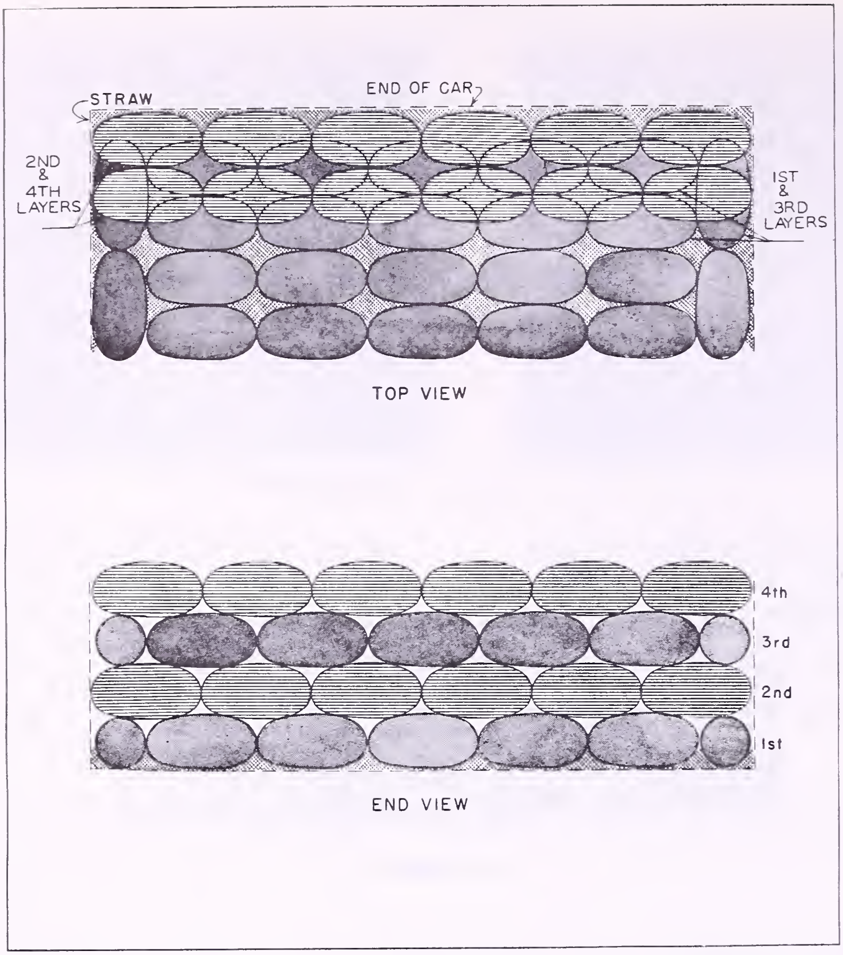

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Figure 7.--Top and end views of crosswise load of long-type melons with lengthwise rows of melons on each side of the first and third layers. The first line of melons in the bottom layer is loaded one-half the width of a melon away from the end wall of the car. Although this arrangement produces a more compact load, it offsets to some extent the principal advantage of the crosswise load as it involves the added risk of blossom-end bruising of the melons in the lengthwise rows.

loading pattern would have to be run in order to produce a statistically significant body of data from which valid conclusions could be drawn. 7/

7/ A 10-percent sampling error was allowed in setting the experimental design for this study. The probability that 100 test shipments would produce results not statistically significant is estimated to be 1 in 20.

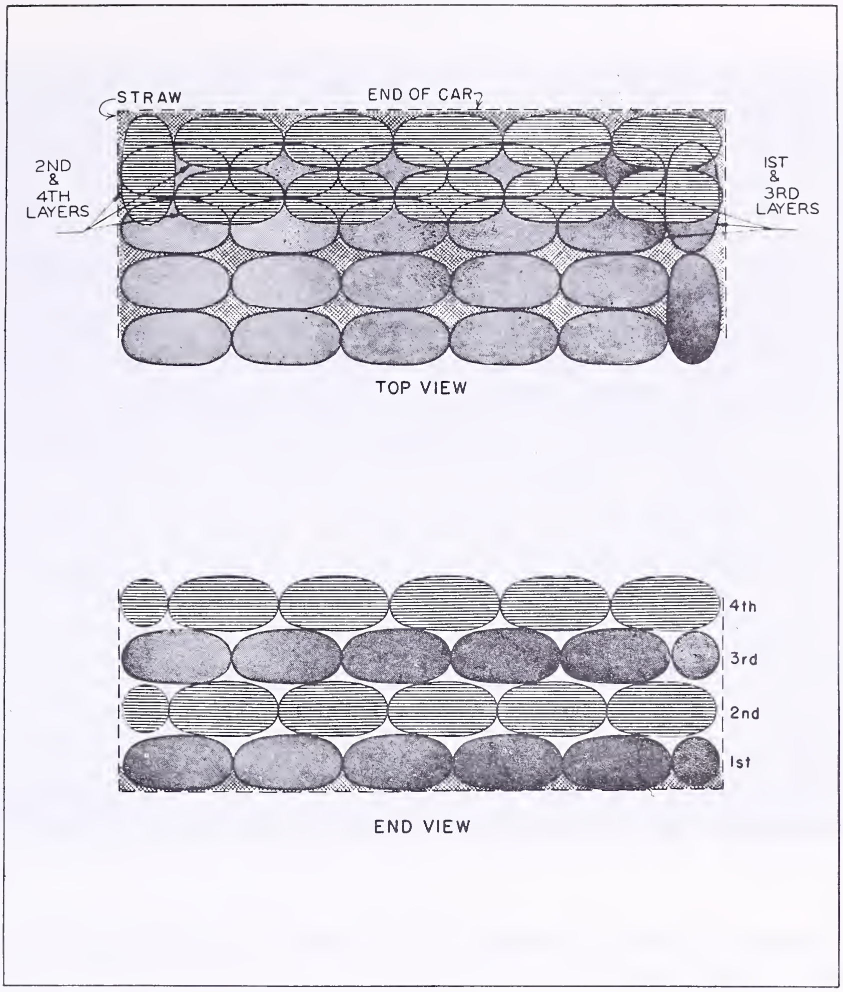

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Figure 8.--Top and end views of crosswise load of long-type melons with one lengthwise row along alternate sides of each layer. In top view, second layer melons are superimposed on those in bottom, or first, layer. The first line of melons in the bottom layer are loaded one-half the width of a melon away from the end wall of the car. Straw or other bedding material is sometimes placed in spaces at sides of first and second layers instead of the lengthwise rows of melons.

The brevity of the watermelon rail shipping season made it impossible to complete the number of test shipments required for the experimental design in a single season. 8/ It was, therefore, necessary to extend the experimental tests over the 2 seasons of 1953 and 1954.

8/ By late July or early August the watermelon harvest had moved up to North Carolina and Virginia from which most of the melons were shipped by truck.

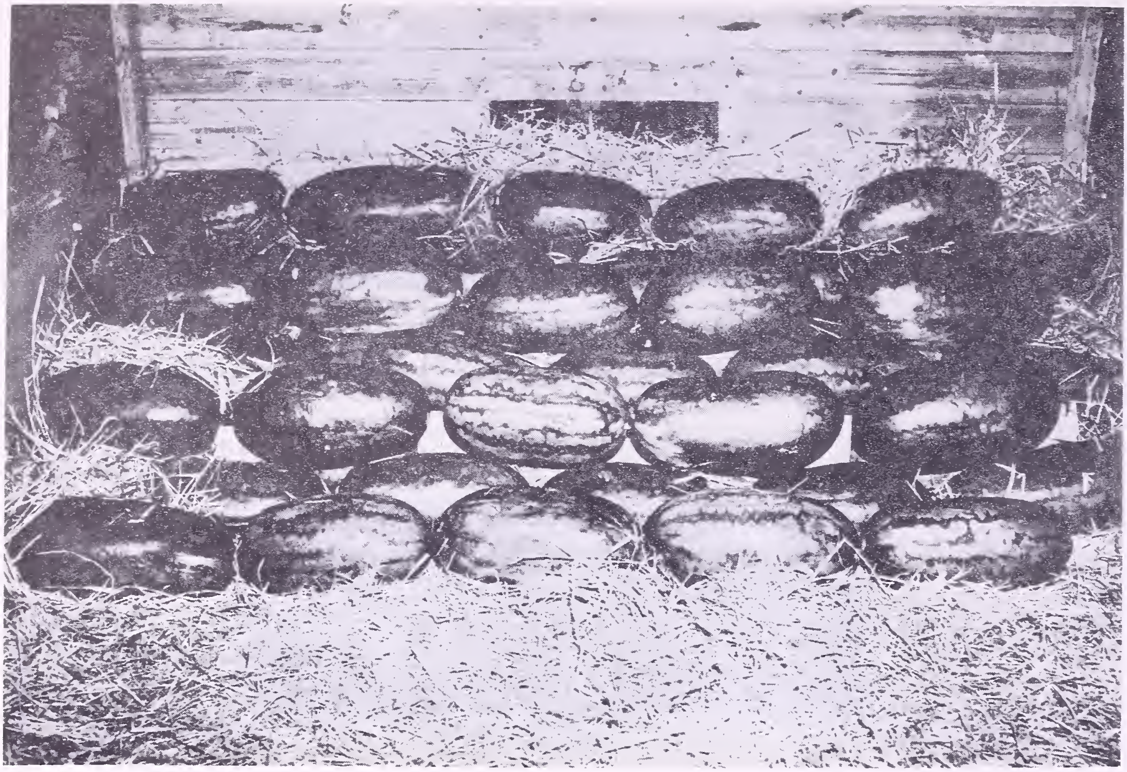

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Figure 9.--Cross section view of a load of Congo watermelons showing how a crosswise load is begun at the end of the car.

In the initial season of the experimental program, 110 carload shipments of melons were made. 9/ Of this number, 45 originated in Florida, 16 in Georgia, and 49 in South Carolina. Fifty of these test shipments were crosswise loads and for each of these there was a companion or check car loaded in the conventional lengthwise method. The purpose of these check cars was to provide comparative data against which the results obtained from the crosswise shipments could be measured. Whenever possible, a test shipment and its companion car were dispatched together to the same destination market, thus traveling identical routes and distances in the same period of time.

9/ This total also included 8 lengthwise split loads of Congo melons. In these split loads one-half of the car was loaded in the usual stem-end-to-blossom-end manner and in the other half, the melons were arranged stem-end-to-stem-end (which means also that they were blossom-end-to-blossom-end.) Results on these 8 cars showed the stem-end-to-stem-end load with a smaller percentage of damaged melons than the conventional stem-end-to-blossom-end arrangement. The difference, however, was not large. For a statistical breakdown of this limited experiment, see the interim report on the results of the 1953 tests, Studies of Watermelon Loading for Rail Shipment, 1953, by P. L. Breakiron and others, Marketing Research Report No. 62, U. S. Agr. Mktg. Serv., May 1954.

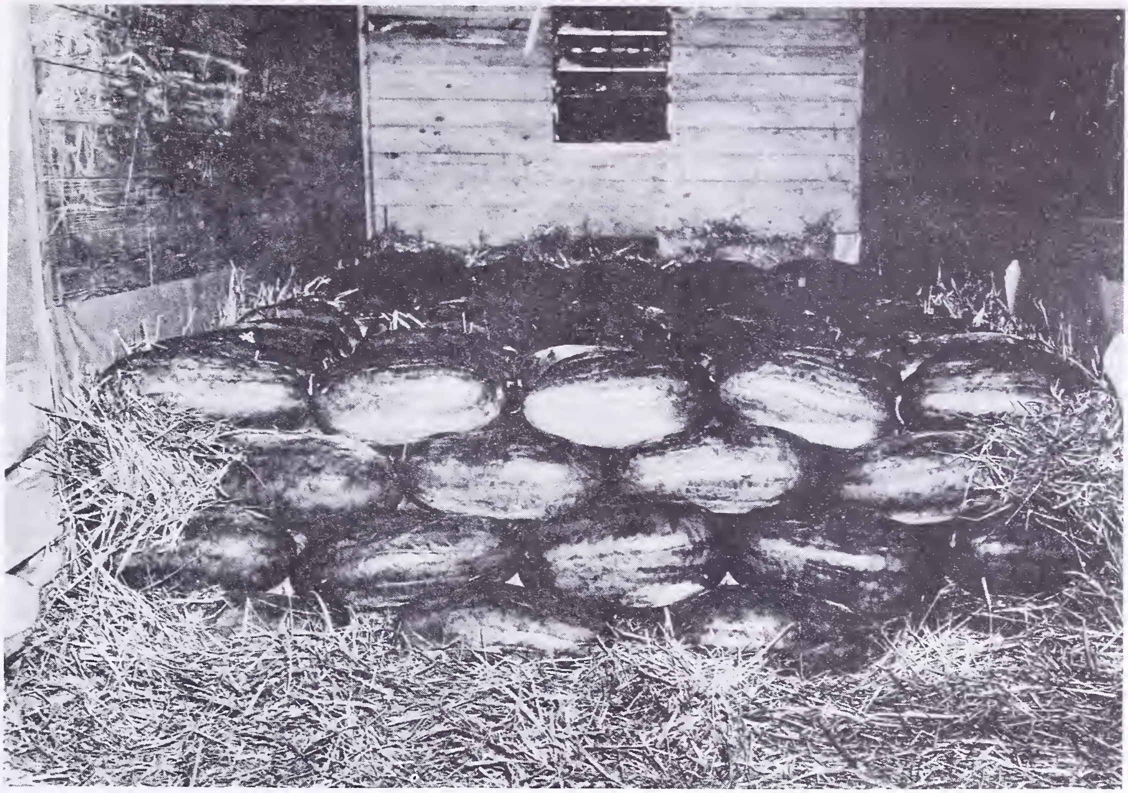

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Figure 10.--Cross section view of a crosswise load of Congo watermelons showing how load has been built from one end of car to doorway area in center of car.

In the 1954 season 143 experimental carloads were originated, but results were obtained on only 132 of them. Rapidly shifting market conditions and diversion of cars in transit were among the factors resulting in the 11 *lost* cars. Of the 132 completed shipments, 78 originated in Florida, 21 in Georgia, and 33 in South Carolina. One hundred and eighteen cars were of the Congo variety, 8 were Fairfax, and 6 were Charleston Grays. The shipments of the Fairfax and Charleston Gray melons were undertaken to determine the comparative behavior of the 2 varieties.

Every effort was made to assure that the conditions under which both the 1953 and 1954 experimental tests were conducted were such as to produce valid data. The melons in both the test and check loads were subjected to the usual inspection by the Federal-State Inspection Service. Representatives of the Department of Agriculture either supervised or actually loaded all the crosswise loads and most of the check carloads. Inspections were also made on the fitness of the cars for loading. Impact recorders, which are designed to measure the comparative intensity of the lengthwise impacts, were installed in approximately half of the test and check loads.

The melons in the experimental loads were inspected at terminal markets. As the melons were removed from the car the amount, type, location, and apparent cause of any visible damage or decay were noted. The condition of the padding, bedding, and other protective material in the cars was also observed. These inspections were made by representatives of the Department of Agriculture and most of them were made jointly with representatives of the Railroad Perishable Inspection Agency and the Western Weighing and Inspection Bureau. A small number of the shipments were inspected by the railroad inspection agencies only.

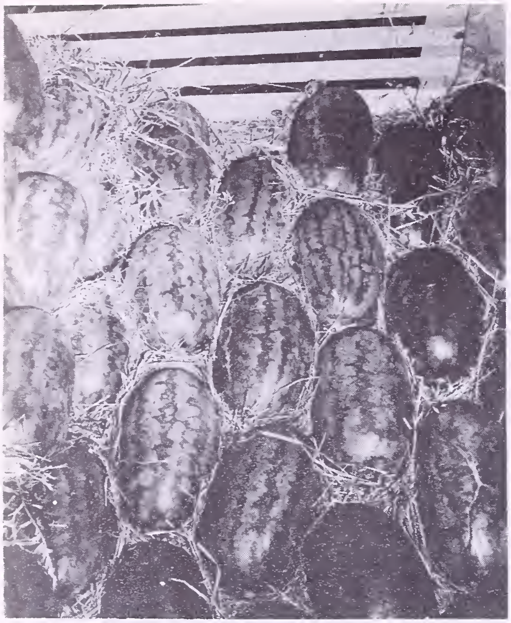

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Figure 11.--Top view of the doorway section of a crosswise load of Congo watermelons showing how two sections of load (one in each end of car) are brought together at this point.

RESULTS

External Damage by Type of Load

The basic objective of the 2-year experimental project reported here was to test the effectiveness of a new method of loading watermelons for rail shipment which, it was hoped, would significantly reduce the heavy loss and damage generally attending use of the conventional lengthwise loading method.

For purposes of analysis, damage found in the test and check shipments has been classified according to three types--cracking, bruising, and scarring. This breakdown makes it possible to evaluate the types of loads in terms of the kinds of damage occurring in each. This is desirable because there are important differences which these various kinds of damage have on the commercial value of a load of melons. Generally speaking, a melon which has been cracked in transit loses all commercial value and represents nothing more than a disposal problem (fig. 12). Under certain market conditions, however, and depending on the severity of the injury, even cracked melons may have some salvage value. Melons which have been bruised also sustain a heavy loss in market value. Again speaking in general terms, they have a higher salvage value than cracked melons. This will depend, however, upon the severity and location of the injury. If the bruise is a bad one and located on a side, the melon will probably be a total loss. Scarring and other types of minor surface injury, while detracting somewhat from the appearance of the melon, usually have little effect on its commercial value.

Decay in a melon is caused by disease and usually destroys its marketable value. Decay may follow a bruise or other injury occurring in pretransit handling or early in transit. Blossom-end decay, for example, may follow physical damage. In such a case, if the decay is confined to a limited area, the melon may have some salvage value.

The data presented in figure 13 show the relative performance of the crosswise and lengthwise loads of Congo melons in the shipping tests conducted in both the 1953 and 1954 seasons. The basic data underlying this figure are shown in table 1 which immediately follows the figure.

The compilation of table 3 of the Appendix affords somewhat similar data for the Fairfax and Charleston Gray varieties. However, since there were few test cars, and these only in the 1954 season, the data do not merit a further detailed discussion here.

The comparisons shown for the Congo melons are made on two bases: (1) Paired shipments (i.e., pairs of cars originating at the same shipping point at the same time and terminated at the same markets) and (2) all test and check cars used in the shipping experiments, regardless of whether or not they went to the same or different destinations. Many of the test and check cars originated at the same shipping points at the same time, but which went to different destinations, traveled at least part of the distance together, usually in the same train.

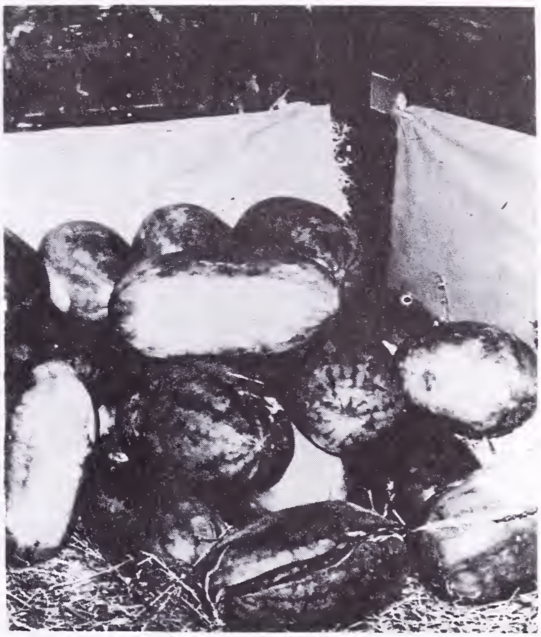

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Figure 12.--Cracked and bruised Congo melons remaining on the car floor after removal of undamaged melons from load.

Paired Cars.--Analysis of the results of the 23 paired carload shipments of Congo melons shows that 10 percent of the melons in the lengthwise loads shipped in the 1953 and 1954 seasons sustained some type of damage, as compared with only 3.2 percent of the melons in the crosswise loads. There was 69.9 percent less total damage in the crosswise loads than in the lengthwise loads.

The principal types of damage were cracking and bruising and the 23 lengthwise cars covering both seasons had an average of 99 cracked and bruised melons versus an average of only 29 for the 23 crosswise loads. In view of the degree of control exercised over these 23 paired shipments and the high degree of comparability, these results probably represent the most conclusive evidence of the superiority of the crosswise load produced by this 2-year experimental program.

The major type of damage to watermelons in transit regardless of loading method has been external bruising. The most significant contribution of the new loading method is the extent to which it has reduced this type of bruising. For the 2 seasons the crosswise load effected a reduction of around 72 percent in the amount of external bruising, or from a total of 2,154 melons an average of 94 bruised melons in the 23 lengthwise loads, to a total of 601 melons an average of 26 bruised melons in the 23 crosswise loads.

The percentage of cracked melons was in no instance really substantial; however, a comparison of the incidences of cracking in the 2 loading patterns shows that for the 2 seasons the crosswise loads reached their destination with only half the number of cracked melons found in the lengthwise loads.

Damage from scarring in relation to total damage proved to be negligible in both types of loads. However, the crosswise load reduced the amount of scarring one-third over that in the lengthwise loads. This reduction is probably attributable to the fact that the crosswise load places less of the melon's surface in contact with the side walls of the car. Had all of the crosswise loads followed the pattern illustrated in figure 6, i.e., without any lengthwise rows, the percentage of scarring would doubtless have been still less.

All Cars.--The data presented in the lower half of figure 13 cover the total amount of transit damage in the entire 220 crosswise and lengthwise carloads of Congos shipped in the 1953

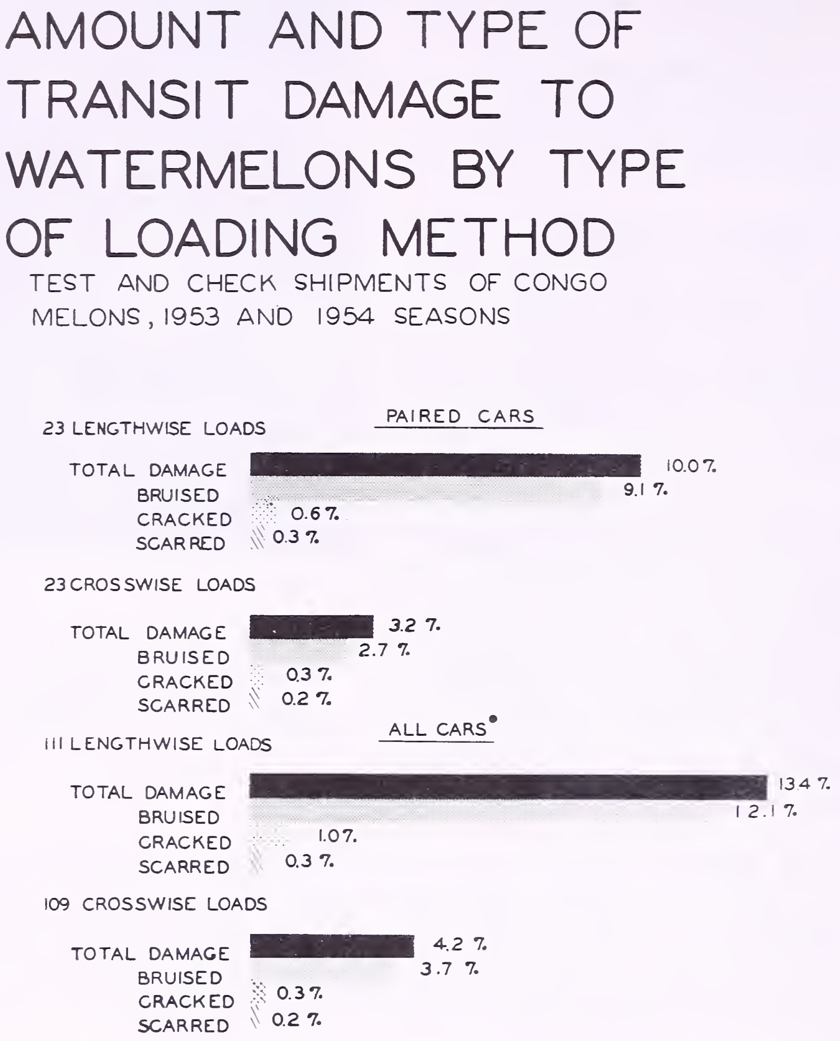

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Figure 13.--Congo watermelons loaded crosswise in 23 test cars sustained less than one-third as much external damage (bruising, cracking, and scarring) as 23 companion cars of comparable melons loaded lengthwise. The cars were loaded at the same time and at the same shipping points, and were shipped to the same markets. Melons in the crosswise test loads had substantially less of each type of damage than comparable melons in the conventional lengthwise loads. Almost identical results were obtained for all 109 crosswise loads shipped during the 2 years of shipping experiments as compared with 111 check shipments loaded by the lengthwise method.

Table 1.--Amount and type of damage in test and check shipments of Congo watermelons by type of load, 1953 and 1954 seasons

Type of load and basis of comparison	Season	Test cars	Total melons per car	Melons damaged per car	Melons with indicated transit damage				Melons decayed	Total transit damage and decay
					Cracked	Bruised	Scarred	Total		
		Number	Number	Number	Percent	Percent	Percent	Percent	Percent	Percent
Paired cars										
Lengthwise..........	1953	12	1,076	141	0.9	11.9	0.3	13.1	3.1	16.2
	1954	11	964	62	0.2	5.8	0.4	6.4	1.4	7.8
Total............	1953-54	23	1,023	103	0.6	9.1	0.3	10.0	2.3	12.3
Crosswise..........	1953	12	973	30	0.2	2.7	0.1	3.0	2.0	5.0
	1954	11	976	32	0.4	2.6	0.3	3.3	1.2	4.5
Total............	1953-54	23	974	31	0.3	2.7	0.2	3.2	1.6	4.8
Average reduction....	1953-54			72	50.8	72.1	45.5	69.9		
All cars										
Lengthwise..........	1953	52	1,047	177	0.9	15.8	0.2	16.9	3.1	20.0
	1954	59	1,031	105	1.0	8.7	0.5	10.2	1.5	11.7
Total............	1953-54	111	1,039	139	1.0	12.1	0.3	13.4	2.2	15.6
Crosswise..........	1953	50	985	49	0.3	4.6	0.1	5.0	1.9	6.9
	1954	59	960	35	0.4	2.8	0.4	3.6	1.1	4.7
Total............	1953-54	109	971	41	0.3	3.7	0.2	4.2	1.5	5.7
Average reduction....	1953-54			98	68.0	71.6	30.6	70.5		
Range both seasons										
Lengthwise..........	1953-54				0 - 25.1	0 - 52.2	0 - 7.7			
Crosswise..........	1953-54				0 - 3.0	0 - 30.9	0 - 2.0			

and 1954 seasons. The underlying factors of this presentation are set forth in table 1 which immediately follows figure 13. In view of the fact that there are no really important deviations in the comparative results of the paired and all-car samples, detailed analysis of the all-car sample is not necessary. The most significant aspect of the comparison of these data covering all cars is the extent to which it confirms the conclusions drawn with respect to the performance of the paired shipments. 10/

In the important bruised melon category the crosswise load did not perform quite so well in absolute terms for the entire 109 shipments as it did in the 23 paired crosswise loads. Compared with the lengthwise load, however, its relative performance was almost identical. The 109 crosswise loads contained 3,883 bruised melons, an average of 35 per car, versus 13,909 in the 111 lengthwise loads an average of 125 per car. Thus for all cars the crosswise load effected a reduction of approximately 72 percent, or the same percentage as the reduction in connection with the paired shipments.

Even in the highest damage range, the crosswise loads have less damage in the 3 damage categories, i.e., cracking, external bruising, and scarring, than did the lengthwise loads. For example, the crosswise load with the greatest number of cracked melons had only one-third as much cracking damage as its lengthwise counterpart load. In the case of externally bruised melons, the crosswise load with the largest number of such melons contained only a little over half the volume of this type of damage as its equivalent lengthwise load. A comparison of the crosswise and lengthwise loads with the most scarring damage revealed two-thirds less damage for the crosswise load. One of the lengthwise test loads had 653 damaged melons out of 1,164 in the car, well over half the melons in the shipment, cracked and bruised externally. Several other cars had similar damage to more than 500 melons in the car.

Decay by Type of Load

The comparative amounts of decay found in the test and check shipments of Congo melons are shown in figure 14. Decay was generally relatively slight, averaging 2.1 percent of the melons in all lengthwise loads and only 1.5 percent of the melons in all crosswise loads. Because of the various factors affecting the infection of melons with different types of decay and the spread of decay, no significance is attached to the difference in favor of the crosswise load.

Over one-half of the total decay was stem-end rot. There were lesser amounts of blossom-end rot and bacterial soft rot. (See table 4 of Appendix.)

Melon Damage and Decay by Crop Harvest

Figure 15 is a graphic presentation of the in-transit damage and decay found in both test and check shipments of Congo watermelons according to type of load and crop harvest, the

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10/ The differences in external damage in favor of the crosswise load were found to be statistically significant. From the analysis of variance in the sample (Method of Unweighted Means, Snedecor, Chap. II) it is concluded that any difference in *angle* means over about 2.0 would be significant. This analysis of variance indicated that the sample was larger than really necessary to recognize the differences in the comparative damage rates of the 2 loading methods as it estimates the means within rather narrow limits.

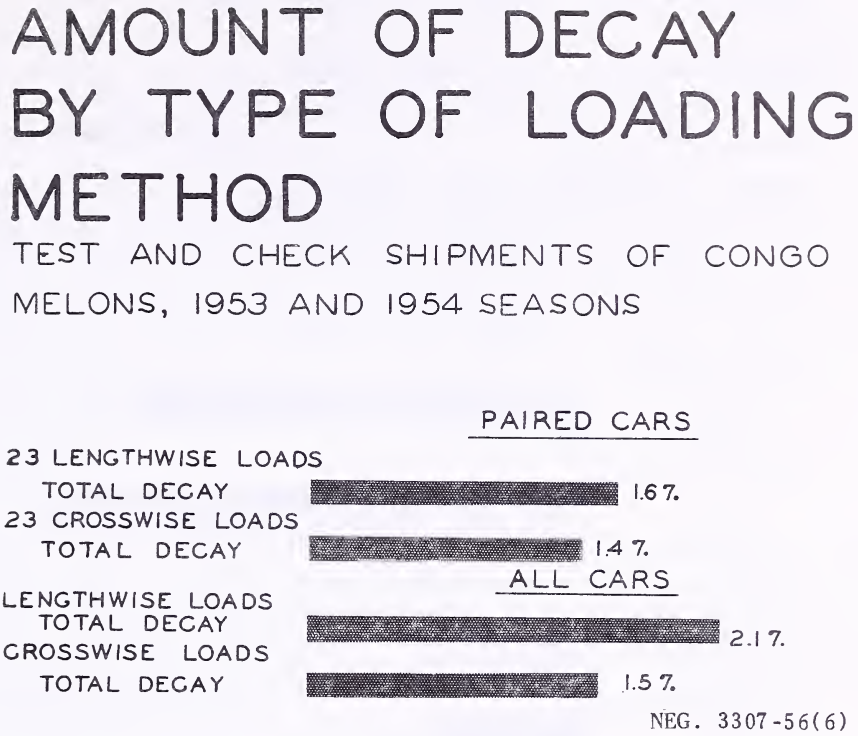

Figure 14.--The total number of decayed melons found in the crosswise test loads was less than the number in the conventional lengthwise check loads. Because of the numerous factors affecting the infection of the melons and the spread of decay, little significance is attached to this difference.

underlying details of which appear in table 5 of the Appendix. This breakdown by early and late harvests shows that there is a relationship between the amount of in-transit damage and decay and stage of harvest from which the melons come. As these data indicate, melons from the first and second crop pickings reach destination markets with a lower percentage of total damage and decay than do those melons gathered in third or later pickings. In order to determine the cause of this variation, an extended series of experiments would be necessary. These data, however, suggest that the melons harvested in the later pickings had reached greater maturity and are, therefore, more susceptible to damage.

There is a tendency at the outset of the season, when the prices are high, for the grower to harvest his watermelons at the earliest possible time. These early melons are generally less mature and therefore less vulnerable to damage. Later in the season, however, growers may, on occasion, defer picking or shipping in the hope that the market prices will improve. But probably the most important factor accounting for greater maturity in the later pickings is weather. The maturation process is increased in the intense heat of late June and July.

The conventional lengthwise shipment data in figure 15 and table 5 of the Appendix show that total bruising and cracking damage amounted to only 12.1 percent in 64 shipments of first and second pickings of melons. In 42 shipments of third and later pickings, there was 14.6 percent damage--an increase of 20.7 percent.

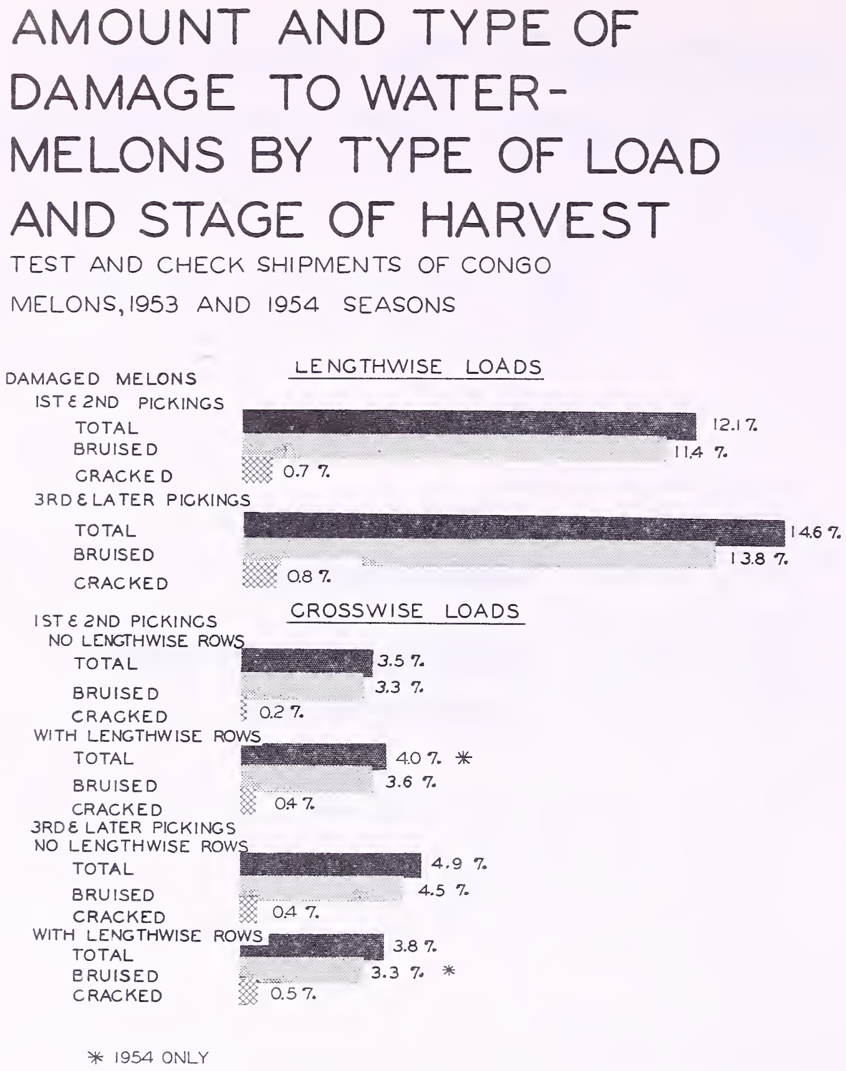

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Figure 15.--Melons from the third and later pickings of the crop sustained more damage in transit than melons from the first and second pickings. This was generally true for both the crosswise and the lengthwise check loads.

The data in figure 15 also provide another basis for a comparison of the effectiveness of the lengthwise and crosswise loads. It will be noted that in every category of damage, and comparing damage rates in the late harvested melons shipped crosswise with damage in the early harvest melons shipped lengthwise, the crosswise load had the best record.

Internal Damage by Type of Load

External bruising and cracking damage occurring to watermelons is visible and it is on the basis of the kind and severity of this damage that claim payments are made.

Frequently, however, melons sustain internal damage to the flesh which is not evidenced by outward appearance. Such injury can occur during shipment or in the preshipment handling of the melons, and may range from slight to very severe. The commercial significance of internal damage to the flesh has become somewhat more important with the growing trend toward retailing melons by halves and quarters.

During the 1953 and 1954 seasons the three agricultural experiment stations of Florida, Georgia, and South Carolina cooperatively conducted a study of the handling of the melons from the field to the cars for loading which included inspections of the internal condition of sample melons from 62 carloads. 11/ In 1953 this study revealed that an average of 21, 25, and 24 percent of the melons examined before loading in Florida, Georgia, and South Carolina, respectively, had internal bruises or cracks. In 1954 the damage averaged 25, 44, and 63 percent for the 3 States. Internal damage ranged from 0 to 100 percent and was found to increase with increased maturity of the melons. Late in the 1954 season it became necessary for Department field workers to suspend shipping experiments entirely as 100 percent of melons being loaded at that time showed some degree of internal damage.

Figure 16 presents data on Congo melons developed through internal inspection by Department personnel of sample melons at destination markets, including test and check loads from which the State experiment station workers at the shipping points also selected melons for internal examination. This determination of internal damage and maturity was made on the basis of a randomly stratified sample usually of 12 melons selected from each layer throughout the entire length of the load.

From all States the lengthwise loads of Congos had slightly more melons free of internal damage and slightly fewer melons with slight and very severe damage than the crosswise load. On the other hand, severe damage was somewhat higher in the lengthwise load. However, the crosswise loads sampled at the shipping point by the State experiment workers averaged more very severe damage before shipment than the companion lengthwise loads. Although the crosswise loads had a somewhat higher percentage of overripe melons than the lengthwise load, the overall maturity of the melons in both types of loads was fairly comparable. Considering all factors, these data show that there was no significant difference in the comparative amounts of internal bruising found in the melons sampled in both types of loads. 12/

Appendix table 6 shows the details underlying figure 16 on Congo melons and contains similar information on the limited number of cars of the Fairfax and Charleston Gray varieties. Inspection of cut melons, including Congo, Fairfax, and Charleston Gray, at destination by Department personnel, broken down by State, showed the following percentages:

11/ Showalter, R. K., Watermelon Handling Methods and Conditions at the Shipping Point, a paper presented at the Seventh Annual Southeastern Short Course on Cause and Prevention of Economic Waste in the Marketing of Fruits and Vegetables, Ala. Polytechnic Inst., Auburn, Ala., Nov. 1954.

12/ Analysis of the variance found in this sample disclosed that it was statistically adequate to reveal any significant difference in the comparative amounts of internal damage found in the melons in the crosswise and lengthwise loads. Standard deviations were of such size that a difference of 12 percent would have appeared significant. A larger sample would only have reduced the difference needed for significance to unimportant levels.

TYPE, SEVERITY AND LOCATION OF INTERNAL DAMAGE AND DEGREE OF MATURITY OF WATERMELONS BY TYPE OF LOADING METHOD

TEST AND CHECK SHIPMENTS OF CONGO MELONS,
1954 SEASON

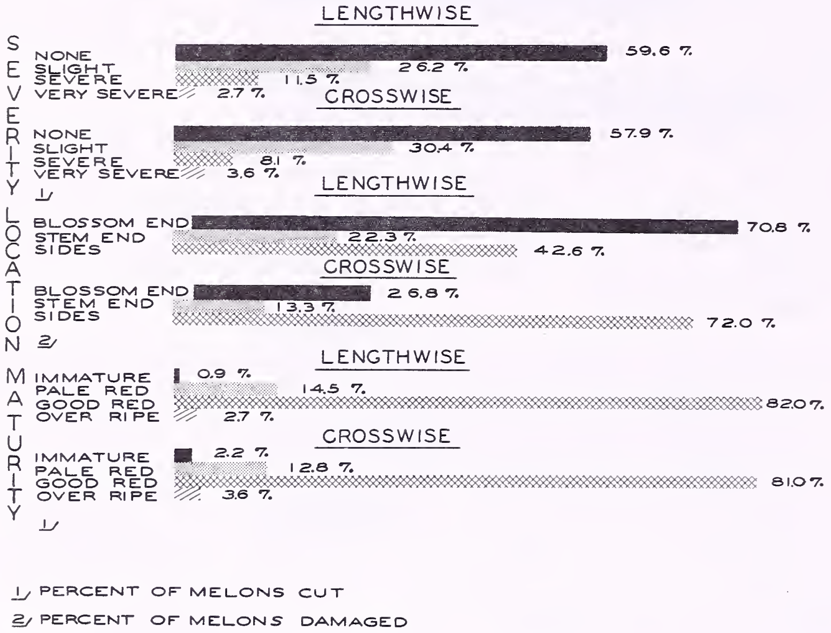

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Figure 16.--The total amount of internal damage (cracking and bruising of the flesh) found in sample melons at destination markets was about the same for both the crosswise and lengthwise loads although there was some variation in the degree of severity of the damage. Although the crosswise loads averaged somewhat more melons with very severe damage, melons from the same cars inspected at the shipping point also averaged more severe damage before transit than those placed in the comparable lengthwise loads. In the lengthwise loads more of the internal damage occurred near the blossom-ends of the melons and in the crosswise loads most of the internal damage was found along the sides of the melons. The maturity of the melons in this sample was fairly comparable although there were a few more overripe melons in the crosswise cars.

State of origin	Percentage of melons cut showing internal damage Lengthwise loads	 Crosswise loads
	Percent	Percent
Florida	29.5	32.4
Georgia	44.4	40.6
South Carolina	59.0	60.6

These data correspond with the 25, 44, and 63 percent of Congo melons found internally damaged at origin by experiment station workers in Florida, Georgia, and South Carolina respectively. 13/

As might be expected, in the lengthwise loads most of the internal injury was found near the blossom ends, while in the crosswise loads, more damage was found along the sides of the melons.

Melon Damage in Relation to Load Pattern - Crosswise Load

One of the objections raised to the crosswise load has been that it does not permit as many melons to be loaded as the lengthwise load. An effort has been made to overcome this objection by filling the 2 car-long voids occurring on each side of the standard crosswise load with lengthwise rows of melons.

Figure 17, based on table 7 of the Appendix, presents comparative data on the damage and decay found in 37 cars of Congo melons with lengthwise rows and 22 cars without them. The lengthwise rows increased the *payload* weight per car, but only at the expense of greater in-transit damage. Total transit damage and decay for the standard crosswise load amounted to 3.2 percent as opposed to 5.6 percent for crosswise loads with lengthwise rows. Most of the increase in damage is found in the *bruised* category. It has not been determined whether the heavier *payload* and the somewhat greater stability of the crosswise load with the lengthwise rows compensates for the higher damage rate resulting from the introduction of lengthwise rows into the crosswise load.

Comparative Time and Material Requirements by Type of Load

Observations by workers of the South Carolina Agricultural Experiment Station during the 1954 season and by AMS personnel in the course of the shipping experiments in both the 1953 and 1954 seasons indicated that little or no additional time was required to load the melons crosswise than to load them lengthwise after the loaders became familiar with the new method.

13/ It was observed by the State experiment station workers that melons from the same sample that were held 5 to 7 days at the shipping point to simulate an average period of transit time averaged 20 percent less internal bruising upon inspection than melons from the same lot inspected at the time the car was loaded. Showalter (footnote 10) commented *This decrease was found in all 3 States and the average decrease of 20 percent was highly significant statistically. One possible explanation would be that the increased redness of the flesh during the storage masked some of the small bruised areas.*

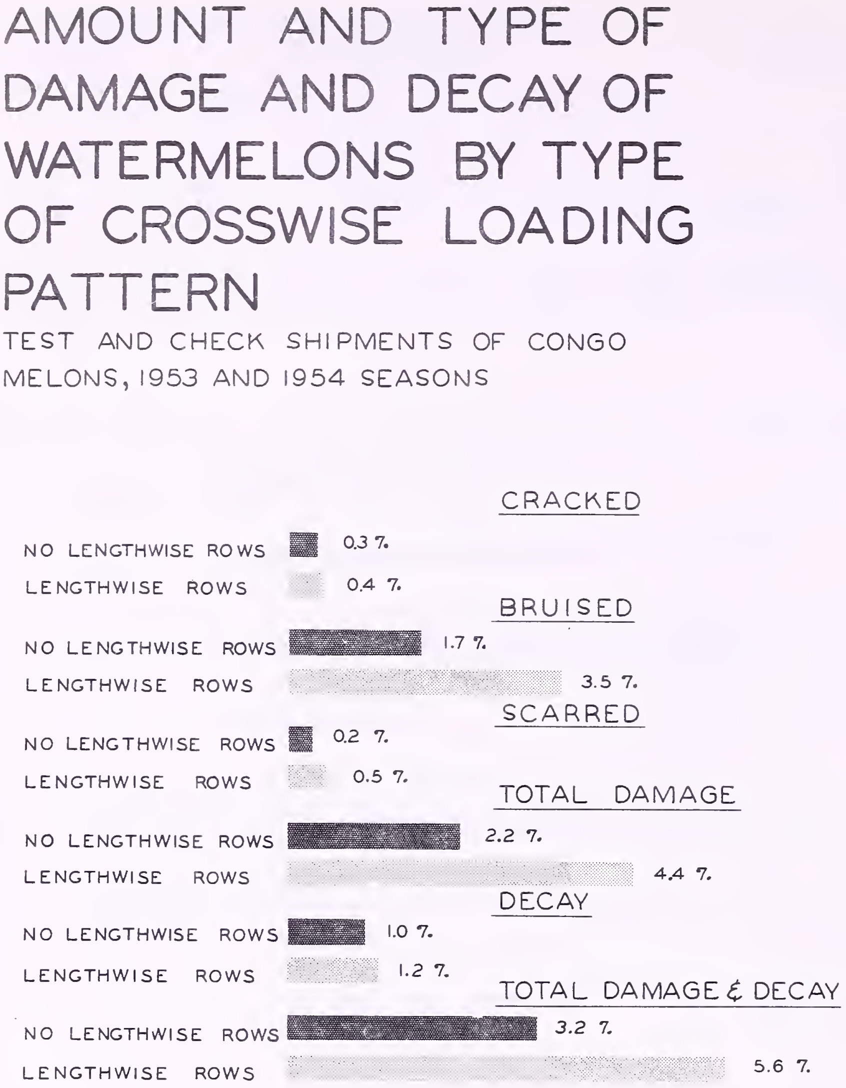

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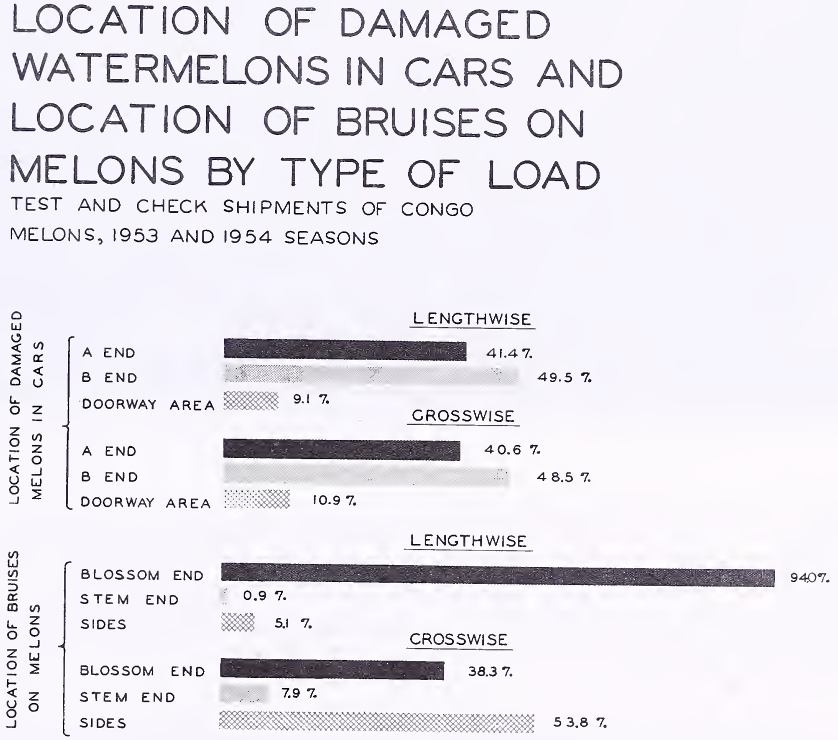
Figure 17.--The crosswise loading pattern with no lengthwise rows of melons along the sides of the loads averaged only half as many damaged melons (2.2 percent) as the patterns with lengthwise rows (4.4 percent). Although there was somewhat less decay and slightly fewer cracked and scarred melons in the all-crosswise pattern, the difference between the 2 load patterns was significantly greater in the number of bruised melons.

The same quantity of straw or other material is used for bedding on the floor of the car and the same type and quantity of end wall padding and side wall lining is used for the crosswise load as for the lengthwise load. The only difference in material requirements of the two loading methods is that the crosswise pattern with no lengthwise rows requires slightly more straw or bedding material if the voids along the car side walls formed by offsetting the layers are packed with bedding material. The cost of the small quantity of bedding material required for this purpose is estimated to be about $1 per car.

Observations at destination markets also indicated that the crosswise loads were somewhat more easily and quickly unloaded than the lengthwise loads. Apparently one reason that the crosswise loads could be unloaded more readily was that the melons, with their ends pointing toward the sides of the car, were in a position where they could be grasped more easily by the unloaders than were the melons in the conventional lengthwise load.

Location of Damage in the Car and on Melons

The data in figure 18, based on table 8 of the Appendix, show that there were fewer damaged melons in the doorway area 14/ of the cars than in the ends of the cars. Although the doorway area of the cars used in these shipments contains about 16 percent of the available loading space, only about 9 percent of the damaged melons in the lengthwise loads and 11 percent in the crosswise loads were found in this part of the car. It is seen that damage was highest in the end of the car toward which the lengthwise impact caused the load to shift.



LOCATION OF DAMAGED WATERMELONS IN CARS AND LOCATION OF BRUISES ON MELONS BY TYPE OF LOAD

TEST AND CHECK SHIPMENTS OF CONGO MELONS, 1953 AND 1954 SEASONS

NEG. 3311-56(6)

Figure 18.--In both the crosswise and lengthwise loads most of the melons showing external damage were in the ends of the car. In the lengthwise loads 94 percent of all bruising was on the blossom ends of the melons as compared with only 38.4 percent in the crosswise loads. In the crosswise loads, however, more of the external damage (53.8 percent) was on the sides of the melons.

14/ Area extending lengthwise of the car equal to the width of doorway opening and across the car from one door to the other.

Not surprisingly, 94 percent of the bruises on the melons in the lengthwise loads for both seasons were found at the blossom end (fig. 19). In sharp contrast, only 38.3 percent of bruises on melons in all the crosswise test shipments were found at the blossom end. As might be expected, more of the bruising found on the melons in the crosswise loads was at the sides and stem end.

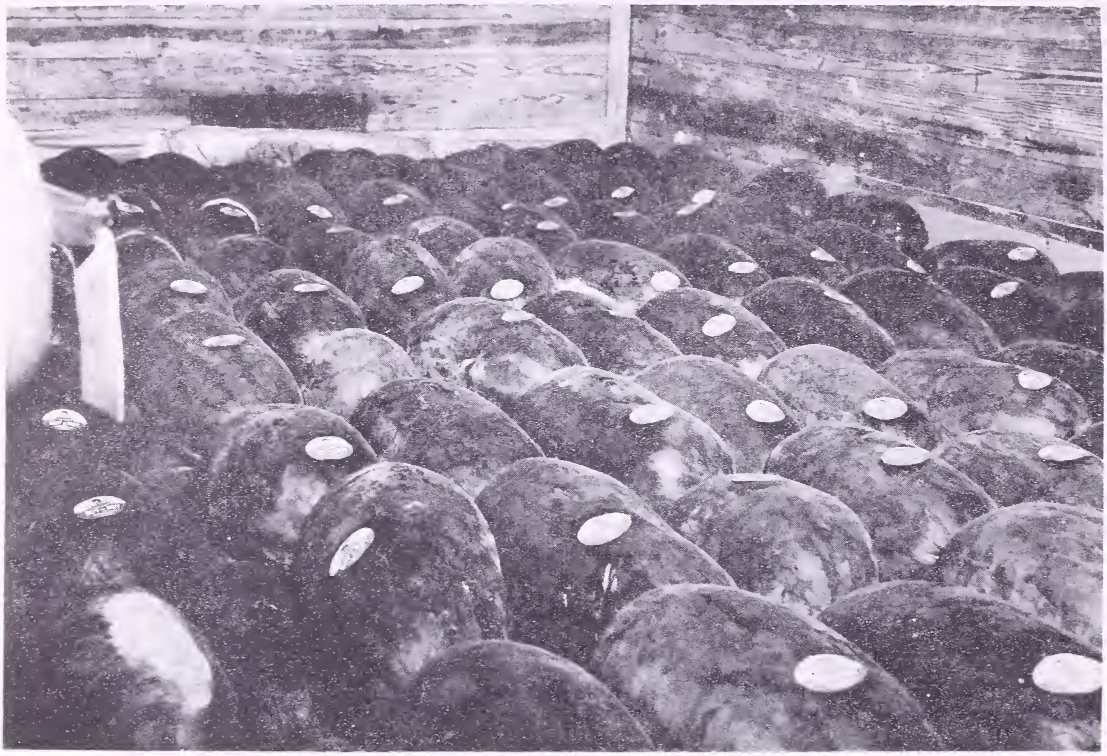


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Figure 19.--Top view of a conventional lengthwise load of Congo watermelons placed stem-end-to-blossom-end in load. In this arrangement the comparatively hard stem ends of the melons in each stack contact the thin, weak blossom ends of the melons in adjacent stacks. Approximately 94 percent of all external bruises are found on the blossom ends.

Melon Damage in Relation to Impact Force

Impact registers were placed in as many test and check shipments as possible in order to determine: (1) The relationship between degree of damage and frequency and severity of lengthwise impacts; (2) the degree of damage occurring by type of load in test and check shipments which received comparable handling and experienced comparable impacts; and (3) the location of the points at which overspeed 15/ impacts occurred. Loss and damage prevention

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15/ Coupling speeds (impact) in excess of 4 miles per hour are generally considered by the railroads as rough handling, since the destructive force transmitted to the car body and hence to the load is considerably greater from impacts at speeds above this rate than below it.

officials of the railroads participating in the haul of each test and check car containing impact registers were furnished with a copy of the impact record for that car. By comparing the impact-occurrence time with the train record for each car, the carrier would have a record of the impacts occurred on its line.

Figure 20, based on table 9 of the Appendix, shows the relationship between the number and severity of lengthwise impacts received and the extent of damage to melons in the test and check shipments for both the 1953 and 1954 seasons.

In both seasons the cars loaded crosswise received more impacts at speeds in excess of 4 miles per hour than did those cars loaded lengthwise, an average of 7.5 as compared with 7.1. Moreover, the average impact force index 16/ was higher (275.7) for the crosswise loads during both seasons than for the lengthwise loads (255.7). Yet, the percentage of melons cracked and bruised was about 3 times as high in the lengthwise loads as in the crosswise loads.

Figure 20 shows a comparison of the average impact force indices and the amount of damage for the two loading methods.

While the 64 crosswise loads with more than average transit damage (Appendix table 10), had only a slightly lower impact force index than the lengthwise shipments (283.2 as opposed to 295.0), the average number of damaged melons per car (107.2 as against 271.6) was considerably lower. For those shipments with less than average transit damage the impact force index was substantially higher for the crosswise loads than for the lengthwise (272.8 as against 232.4), yet the average number of melons damaged per car was 17.4 for the crosswise loads in contrast to 68.6 melons per car for the lengthwise loads. This material reduction in damage by the crosswise load even under more severe handling conditions lends additional significance to the data on the performance of the crosswise load.

Table 2 indicates the percentage of impacts received at various speeds in excess of 4 miles per hour and the percentage of these over-speed impacts received in yards or terminals.

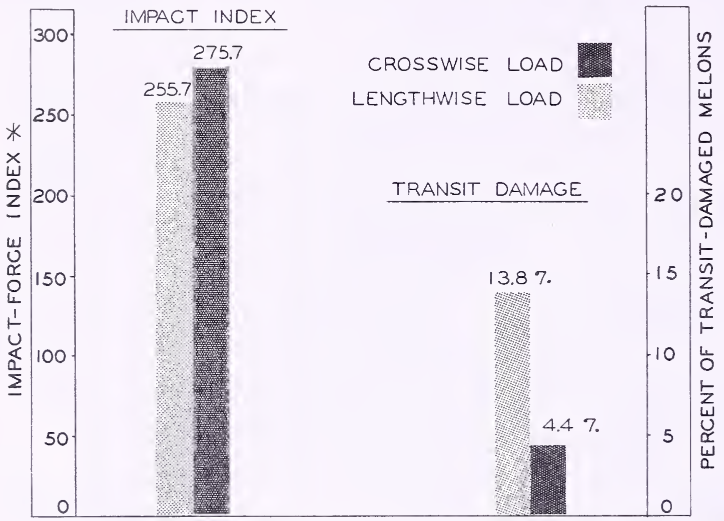
For 51 lengthwise loads for the 1953 and 1954 seasons, 79 percent of the impacts above 4 miles per hour received by the cars occurred in yards and terminals, and for 64 crosswise loads 79.9 percent of the impacts received were in yards and terminals. Table 2 also shows that most of the over-speed impacts (4 miles per hour is the top speed for so-called normal handling) were from 5 to 7 miles per hour. There were relatively few impacts at speeds above 7 miles per hour.

These data suggest that greater care in car handling, particularly in yards and terminals, would significantly reduce the amount of damage to melons in transit.

16/ *Average Impact Force Index* is the summation of the squares of the speeds of impact above 4 miles per hour. Findings of railroad research technicians indicate that the force of the impacts received by a load increases in approximately the same ratio as the squares of the striking speeds.

TOTAL TRANSIT DAMAGE TO WATERMELONS AND IMPACT–FORCE INDEX BY TYPE OF LOAD

TEST AND CHECK SHIPMENTS OF CONGO MELONS, 1953 AND 1954 SEASONS



* OBTAINED BY SUMMATION OF SQUARES OF SPEED OF IMPACTS, SINCE DESTRUCTIVE FORCE TRANSMITTED TO LOAD INCREASES APPROXIMATELY THE SAME RATIO AS THE SPEED OF IMPACT SQUARED.

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Figure 20.--Although all crosswise test loads with impact recording instruments in them averaged only about one-third (4.4 percent) as much damage as the conventional lengthwise check loads which contained recording instruments, the average impact force index (a measure of the damage-producing lengthwise impacts transmitted to the loads during transit) was higher (275. 7) for the crosswise loads than for the lengthwise loads (255.7). The average damage rates shown here for each type of load covers only those cars which contained impact registers.

Table 2.--Percentage of impacts above 4 miles per hour at different speeds and locations at which received, rail shipments of Congo watermelons by type of load, 1953 and 1954 seasons

Type of load	Year	Cars with impact registers	Percentage of impacts above 4 miles per hour							Percent of total impacts occurring in yards or terminals 1/
			5 miles per hr.	6 miles per hr.	7 miles per hr.	8 miles per hr.	9 miles per hr.	10 miles per hr.	11 miles per hr.	
		Number	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent
Conventional										
Lengthwise loads..	1953	23	58.6	22.3	10.2	1.9	4.4	1.3	1.3	77.7
	1954	28	49.7	26.8	14.1	4.9	1.5	1.5	1.5	80.0
Both seasons....	1953-54	51	53.6	24.8	12.4	3.6	2.8	1.4	1.4	79.0
Crosswise loads...	1953	31	58.5	20.8	9.0	7.2	2.7	1.8	0	75.2
	1954	33	48.7	25.7	14.2	5.7	1.9	2.3	1.5	83.9
Both seasons....	1953-54	64	53.2	23.4	11.8	6.4	2.3	2.1	0.8	79.9

1/ These percentages necessarily involve some estimation as the train running information furnished by the railroads from which these determinations were made was, in some cases, incomplete.

APPENDIX

Table 3.—Amount and type of damage found in test and check shipments of Fairfax and Charleston Gray watermelons by type of load, 1954 season 1/

Type of load and basis of comparison	Test cars	Total melons per car	Melons damaged per car	Melons with indicated transit damage				Melons decayed	Total transit damage and decay
				Cracked	Bruised	Scarred	Total		
	Number	Number	Number	Percent	Percent	Percent	Percent	Percent	Percent
Fairfax variety									
Lengthwise	5	1,105	116	1.5	8.3	0.7	10.5	4.0	14.5
Crosswise	3	1,003	23	0.5	1.1	0.6	2.2	0.8	3.0
Charleston Gray variety									
Lengthwise	3	959	98	0.5	9.2	0.5	10.2	1.4	11.6
Crosswise	3	918	17	0.1	0.8	0.9	1.8	0.4	2.2
Combined Fairfax and Charleston Gray varieties									
Lengthwise	8	1,050	109	1.2	8.6	0.6	10.4	3.1	13.5
Crosswise	6	960	20	0.3	1.0	0.8	2.1	0.6	2.7
Average reduction			89	75.8	89.5	2/ 19.4	81.7		

1/ There were no test shipments of Fairfax and Charleston Gray varieties during the 1953 season.
2/ Increase.

Table 4.--Amount and type of decay found in test and check shipments of Congo watermelons, by type of load, 1953 and 1954 seasons

Type of load and basis of comparison	Year	Total decay	Type of decay (percentage of total decayed melons)								
		Percent of total melons in cars	Anthracnose	Stem end rot	Bacterial soft rot	Blossom end rot	Rhizopus rot	Internal souring	Soil rot	Mycosphaerella rot	Other or unknown
		Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent
Paired cars											
Lengthwise loads											
10 cars..............	1953	1.7	0.6	69.3	11.7	14.5	0	0	1.7	0	2.2
9 cars..............	1954	1.5	5.4	10.9	16.3	20.9	0	0	0	46.5	0
19 cars--both seasons.	1953-54	1.6	2.6	44.8	13.6	17.2	0	0	1.0	19.5	1.3
Crosswise loads											
10 cars..............	1953	1.8	0	78.2	10.0	8.2	0.6	2.4	0	0	0.6
9 cars..............	1954	1.0	0	23.9	25.0	0	0	0	0	39.8	11.3
19 cars--both seasons.	1953-54	1.4	0	59.7	15.1	5.4	0.4	1.5	0	13.6	4.3
All cars											
Lengthwise loads											
45 cars..............	1953	2.8	0.7	58.2	11.3	19.2	0.2	1.6	1.2	0	7.6
39 cars..............	1954	1.3	2.1	30.9	13.0	14.3	0	4.1	0	11.6	24.0
84 cars--both seasons.	1953-54	2.1	1.1	50.6	11.7	17.9	0.1	2.3	0.9	3.2	12.2
Crosswise loads											
38 cars..............	1953	1.9	1.4	75.5	9.4	8.4	0.4	1.0	1.6	0	2.3
45 cars..............	1954	1.2	[1]23.9	33.3	20.3	5.5	0	1.2	0	9.1	6.7
83 cars--both seasons.	1953-54	1.5	10.7	58.0	14.0	7.2	0.2	1.1	0.9	3.8	4.1

[1] All in one car.

Table 5.--Amount of transit damage and decay found in test and check shipments of Congo watermelons from early and late harvests, by type of load, 1953 and 1954 seasons

Type of load and time of harvest	Year	Test cars	Percentage of melons with indicated damage			Melons decayed	Total percentage of damaged & decayed melons
			Cracked	Bruised	Total		
		Number	Percent	Percent	Percent	Percent	Percent
Conventional							
Lengthwise loads							
1st and 2nd pickings.......	1953	27	0.9	13.7	14.6	2.4	17.0
	1954	37	0.7	9.7	10.4	1.3	11.7
Both seasons............	1953-54	64	0.7	11.4	12.1	1.8	13.9
3rd and later pickings 1/..	1953	23	1.1	19.1	20.2	3.7	23.9
	1954	19	0.5	7.1	7.6	1.7	9.3
Both seasons............	1953-54	42	0.8	13.8	14.6	2.8	17.4
Crosswise loads							
1st and 2nd pickings (Without lengthwise rows)..	1953	29	0.3	4.4	4.7	2.0	6.7
	1954	16	0.2	1.1	1.3	1.2	2.5
Both seasons...........	1953-54	45	0.2	3.3	3.5	1.7	5.2
(With lengthwise rows).....	1954	21	0.4	3.6	4.0	1.0	5.0
3rd and later pickings 1/ (Without lengthwise rows)..	1953	21	0.4	4.9	5.3	1.8	7.1
	1954	6	0.4	3.1	3.5	0.5	4.0
Both seasons...........	1953-54	27	0.4	4.5	4.9	1.5	6.4
(With lengthwise rows).....	1954	16	0.5	3.3	3.8	1.4	5.2

1/ Includes some cars which intermingled melons from both the 2nd and 3rd pickings.

Table 6.--Severity, type, and location of internal damage, and maturity and ripeness found in test and check shipments of long-type watermelons at destination, by type of load, 1954 season

Variety and type of load	Test cars	Melons cut	Internal damage to melons cut				Type of damage to melons cut			Location 1/ of damage			Maturity and ripeness of melons cut			
			None	Slight	Severe	Very severe	Water-soaking	Live color	Flesh shattering	Blossom end	Stem end	Sides	Im-mature	Pale red	Good red	Over-ripe
	Number	Number	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent
Congo																
Lengthwise	31	332	59.6	26.2	11.5	2.7	35.5	4.5	10.5	70.8	22.3	42.6	0.9	14.5	81.9	2.7
Crosswise	42	468	57.9	30.4	8.1	3.6	36.3	3.8	13.0	26.8	13.3	72.0	2.2	12.8	81.4	3.6
Fairfax																
Lengthwise	4	39	59.0	25.6	15.4	0	30.8	2.6	5.1	56.2	31.2	50.0	0	0	89.7	10.3
Crosswise	2	18	83.3	11.1	0	5.6	16.7	0	0	66.3	0	66.3	0	0	77.8	22.2
Charleston Gray (#5127 Variety)																
Lengthwise	3	36	80.6	11.1	5.5	2.8	16.7	5.5	5.5	66.0	18.7	18.7	0	0	100.0	0
Crosswise	3	36	88.9	8.3	0	2.8	8.3	0	8.3	25.2	0	49.5	0	0	100.0	0

1/ These percentages do not total 100 because of damage in some melons at two or more locations.

Table 7.--Amount of transit damage and decay found in shipments of Congo watermelons loaded crosswise with and without alternate lengthwise rows at side walls, 1954

Type of load and basis of comparison	Test cars	Total melons in cars inspected	Melons damaged				Melons decayed	Melons damaged and decayed in transit
			Cracked	Bruised	Scarred	Total		
	Number	Number	Percent	Percent	Percent	Percent	Percent	Percent
Crosswise loads								
Without lengthwise rows	22	20,332	0.3	1.7	0.2	2.2	1.0	3.2
With lengthwise rows 1/	37	36,289	0.4	3.5	0.5	4.4	1.2	5.6

1/ From 1 to 4 lengthwise rows--usually 1 row along the alternate sides of each layer.

Table 8.—Location of damaged melons in cars and location of bruises on melons found in test and check shipments of Congo watermelons by type of load, 1953 and 1954 seasons 1/

Type of load	Year	Test cars	Location of damaged melons in cars (Percentage of total damaged)			Location of bruises on melons (Percentage of total bruises)		
			A end of car 2/	B end of car 3/	Doorway area 4/	Blossom end	Stem end	Sides
		Number	Percent	Percent	Percent	Percent	Percent	Percent
Conventional								
Lengthwise loads...	1953	24	38.7	53.5	7.8	95.3	0.5	4.2
	1954	24	46.9	41.4	11.7	91.3	1.8	6.9
Both seasons.....	1953-54	48	41.4	49.5	9.1	94.0	0.9	5.1
Crosswise loads....	1953	37	43.2	46.8	10.0	40.1	11.1	48.8
	1954	31	36.3	51.3	12.4	35.3	2.5	62.2
Both seasons.....	1953-54	68	40.6	48.5	10.9	38.3	7.9	53.8

1/ Includes only cars for which data were adequately comparable to permit segregation of damage by location.

2/ Opposite end from the brake end.

3/ Brake end of car.

4/ Area extending lengthwise of car equal to width of doorway opening and across the car from one door to the other. Calculated on basis of 36-foot (inside length) ventilated boxcar.

Table 9.—Comparison of number and intensity of lengthwise impacts in transit received by test and check cars of Congo watermelons and percentage of damaged melons by type of load, 1953 and 1954 seasons

Type of load	Year	Cars with impact registers	Impacts occurring at speeds of more than 4 miles per hour 1/	Average impacts occurring at speeds of more than 4 miles per hour	Average impact force index per car 2/	Percentage of cracked and bruised melons
		Number	Number	Number	Number	Percent
Conventional						
Lengthwise loads.	1953	23	157	6.8	241.1	16.0
	1954	28	205	7.3	267.8	12.1
Both seasons...	1953-54	51	362	7.1	255.7	13.8
Crosswise loads..	1953	31	222	7.2	251.5	5.0
	1954	33	261	7.9	298.5	3.9
Both seasons...	1953-54	64	483	7.5	275.7	4.4

1/ Impacts occurring at speeds of more than 4 miles per hour are considered by railroads to constitute rough handling.

2/ Summation of the squares of the speeds of impact. The destructive force transmitted to the load increases at approximately the same ratio as the squares of the speeds of impact.

Table 10.—Average impact force index for rail shipments of Congo watermelons with more than and less than average damage, by type of load, 1953 and 1954 seasons

Type of load	Year	Test cars	Melons cracked and bruised—average per car	Shipments with more than average transit damage			Shipments with less than average transit damage		
				Cars	Average melons damaged per car	Average impact force index 1/	Cars	Average melons damaged per car	Average impact force index 1/
		Number	Number	Number	Number	Number	Number	Number	Number
Conventional									
Lengthwise loads	1953	23	164.1	9	299.5	326.2	14	77.1	186.4
	1954	28	127.9	10	246.4	266.9	18	62.0	268.2
Both seasons..	1953-54	51	144.2	2/ 19	271.6	295.0	2/ 32	68.6	232.4
Crosswise loads.	1953	31	49.7	8	129.5	249.0	23	18.3	252.3
	1954	33	38.6	10	89.4	310.5	23	16.6	293.2
Both seasons..	1953-54	64	44.0	2/ 18	107.2	283.2	2/ 46	17.4	272.8

1/ As the destructive force transmitted to the load increases at approximately the same ratio as the square of the speed of impact, the index for each car represents the sum of the squares of the striking speeds for each impact above 4 miles per hour.

2/ Sample averages of data for both seasons.

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